SOUTHERN RESEARCH INSTITUTE

Cooperative Agreement No. DE-FC26-00NT40770

Southern Fine Particulate Monitoring Project

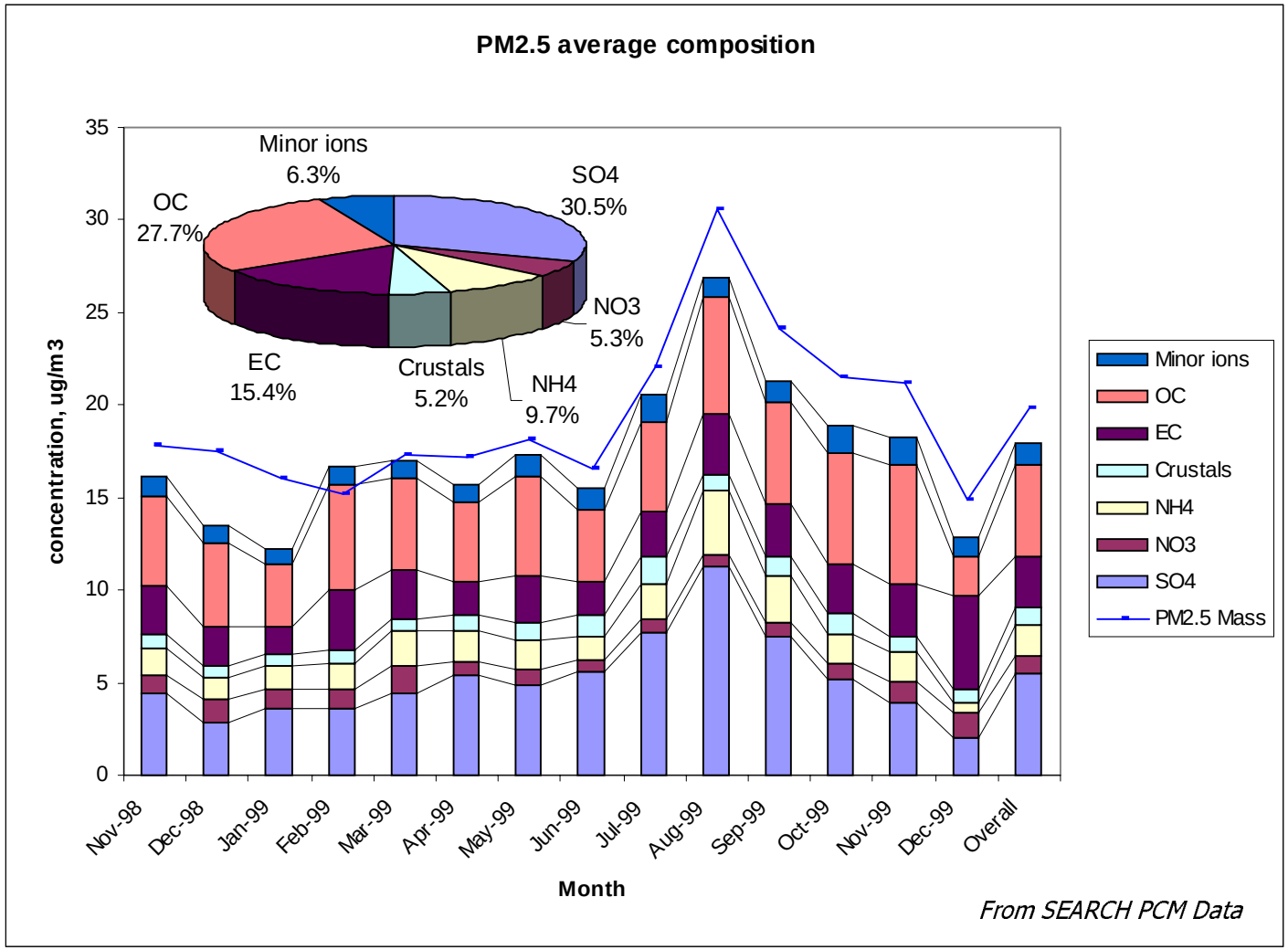
Objectives

- Augment existing particulate measurements at an established urban southeastern monitoring site
- Make a detailed database of near-continuous measurements of fine particulate mass, composition, and key properties (including particle size distribution)
- Apply the measurements to source attribution, time/transport properties of fine PM, and implications for management strategies for $PM_{2.5}$
- Maintain high level of collaboration with other regional $PM_{2.5}$ research programs
- Focus areas: continuous composition and sizing; source attribution; carbonaceous and water content

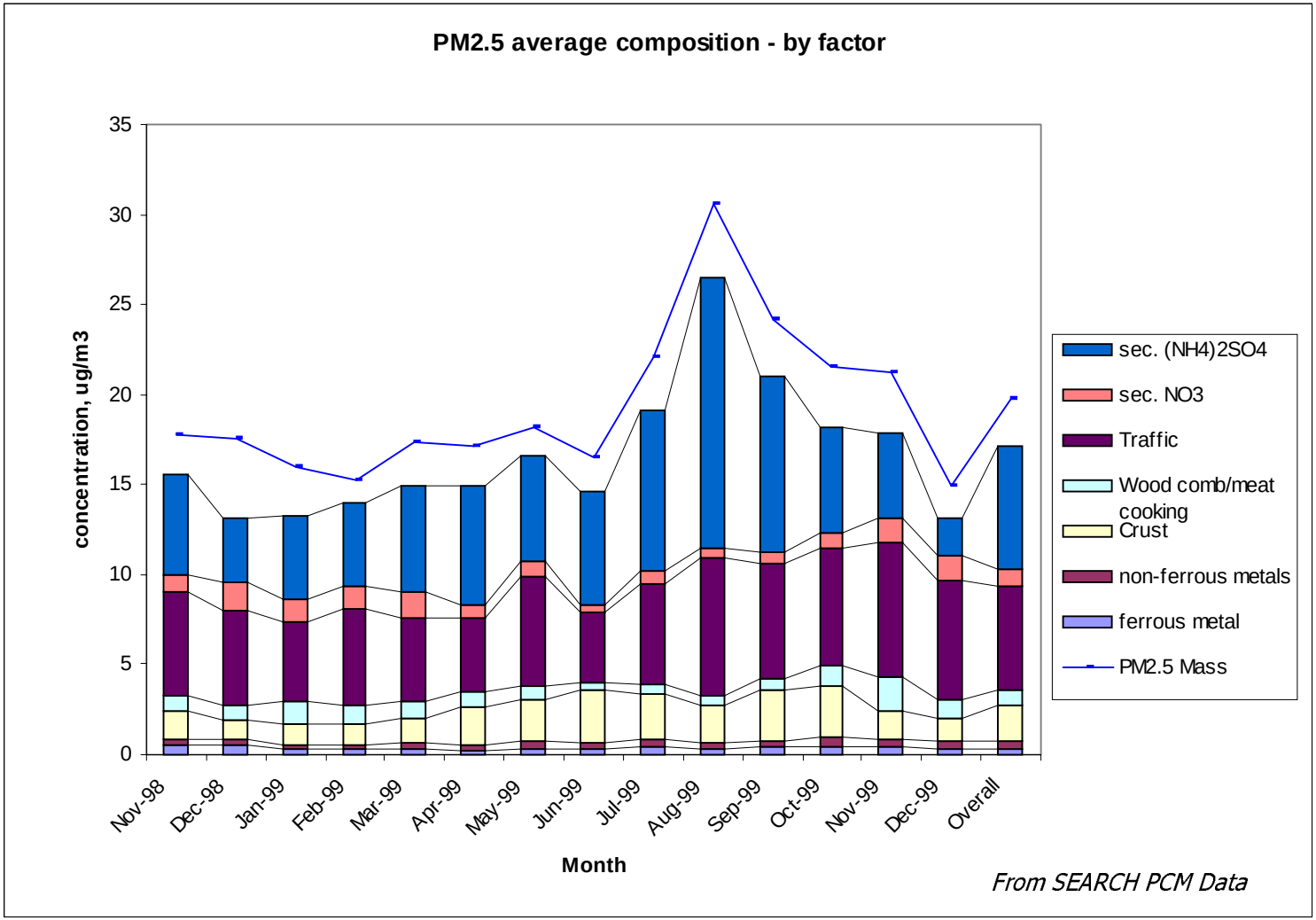
Features of Birmingham Airshed

- Nonattainment for O_3, $PM_{2.5}$
- Southeastern climate
  - high "regional" $PM_{2.5}$ relative to source
- Ridge/valley topology and meteorology
  - local transport, mixing patterns
- Fewer major upwind regional sources
  - directional signatures possible
- Distinctive local source mix
  - mobile, metallurgical, vegetative

Birmingham PM Composition



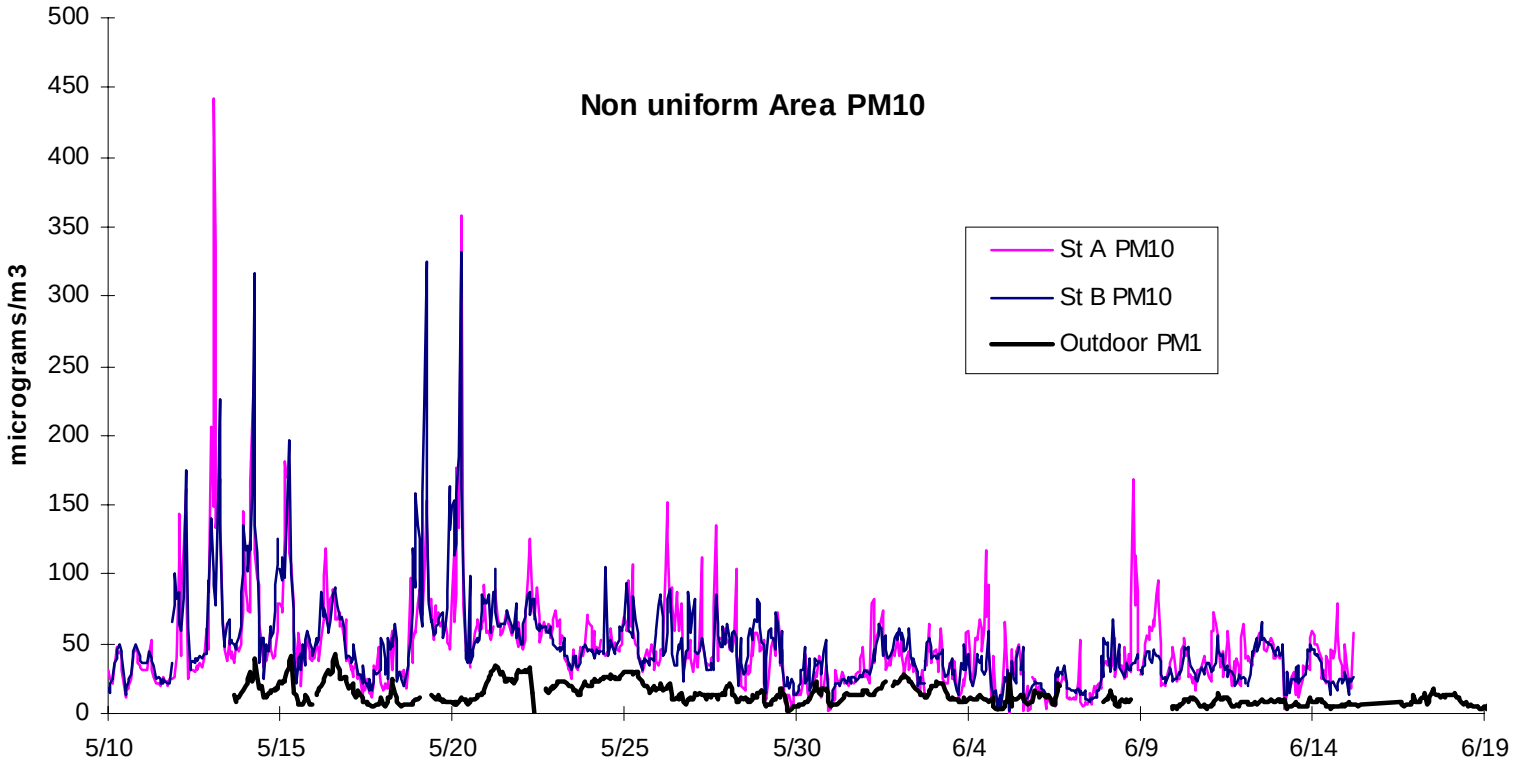
Birmingham PM Composition



Birmingham PM Knowledge Gaps

- Carbon PM : nature, sources, quantity
  - OC uncertainty
- Coarse PM : nature, sources, distribution
  - poor mass balance, spatial inhomogeneity
- Particle-bound water effects
- Main local, regional sources of PM

Coarse PM Issues



Project Approach

- Establish Collaboration With Existing Programs Using North Birmingham Site (Jefferson County, SEARCH)
- Assemble Instrument Package for Continuous Monitoring of Ambient Fine Particulate Mass, Composition, and Key Properties (Including Particle Size Distribution)
- Use Site as a Test Bed for Particulate Measurement Technique Development, Evaluation During Intensive Tests
- Apply increased predictive strength to local and mid-range source attribution models (PMF variants)
- Apply air quality modeling to time/transport properties of fine PM, and implications for management strategies for $PM_{2.5}$

North Birmingham Monitoring Site

North Birmingham Monitoring Site

North Birmingham Monitoring Site

North Birmingham Monitoring Site

Existing Samplers at Site

- PM Mass
  - FRM (24 Hour) : $PM_{2.5}$
  - TEOM (Continuous) : $PM_{2.5}$, PM_{10}
- PM Chemistry
  - $PM_{2.5}$ (24 Hour) : $SO_4^{=}$,NH_4^{+},NO_3^{-}, OC/EC, trace elements
  - PM_{coarse} (24 Hour) : $SO_4^{=}$,NH_4^{+},NO_3^{-}, trace elements
  - $PM_{2.5}$ (Continuous) : OC/EC (Absorption)

Existing Samplers at Site

- Gases
  - O_3
  - NO, NO_2, NO_y, SO_2, CO
- Surface Meteorological Data
  - Wind Direction, Wind Speed, Temperature, Relative Humidity, Barometric Pressure, Precipitation

Planned New Samplers At Site

- PM Mass
  - TEOM (Continuous) : PM_{coarse}
  - Light Scattering : nephelometer
- PM Chemistry
  - $PM_{2.5}$ (24 h integrated): EPA Speciation Site
  - $PM_{2.5}$ (Continuous): $SO_4^{=}$,NH_4^{+},NO_3^{-},
- PM Sizing
  - Aerodynamic Particle Sizer-TSI
  - Scanning Mobility Particle Sizer-TSI

PM Source Attribution Studies

- Positive Matrix Factorization (PMF) and extensions:
  - Complete 24 hr samples, extend with 2000 data
  - Extend model with Met variables, Coarse PM
  - Incorporate continuous mass, met, size, composition data when available into treatment
- Separate treatment of local, regional PM sources
  - Back trajectory, Potential Source Contribution Function (PSCF) analysis

PM Method Development Studies

- Carbon PM: further time differentiation of "OC"
  - sensitivity to alternate thermal cycles
  - Can low temperature (<300C) volatilization mass loss tests determine "OC"/ Carbon mass ratio for local sources?
- Particle-bound water effects
  - TDMA during intensives
  - Fixed vs. ambient RH for PSD - suitability for PSD as source tracer

Schedule / Milestones